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DEVELOPING INTERDISCIPLINARY RESEARCH GRADUATES: EDUCATIONAL OPPORTUNITIES AND DILEMMAS

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Attempting to solve the complex problems of the 21st century requires research graduates that have developed a sophisticated array of interdisciplinary teamwork and communication skills. Although universities have emphasised the need to break down disciplinary silos in order to produce graduates, who can respond more effectively to the needs of the knowledge economy, much of this work has centred on undergraduate programs. While there are some research higher degree students who choose to work on interdisciplinary research topics, very little has been done to develop interdisciplinary research education systematically. This paper explores the educational opportunities and dilemmas involved in developing systematic programs of interdisciplinary research activities in two research centres at the University of Queensland. Framed by Bruhn’s (2000) theoretical discourse about interdisciplinary research, this paper emphasises the need for such programs to embed the development of students’ interdisciplinary research skills and attitudes within their research projects. The two diverse programs also emphasise experiential, active and interactive learning techniques and are centred upon the development of students’ reflective practice skills.

Interdisciplinary research centres have started to flourish in universities around the globe in the 1990s and 2000s and a corresponding, burgeoning literature has emerged on the joys and challenges involved in interdisciplinary research. Indeed, interdisciplinarity is now in danger of becoming an empty buzzword, bandied about by everyone but meaning very little. Like most popular terms, the definition of interdisciplinarity is contested. Debates rage about whether particular research projects are multidisciplinary, cross-disciplinary, pluridisciplinary, transdisciplinary, or interdisciplinary. In 1972, the OECD (quoted in Grigg, 1999, p. 4) attempted to differentiate these various terms. They decided that:

- **Multidisciplinary** [meant] the juxtaposition of various disciplines, sometimes with no apparent connection between them.
- **Pluridisciplinary** [was] the juxtaposition of disciplines assumed to be related ...
- **Interdisciplinary** [involved] the interaction among two or more different disciplines ... ranging from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data ...
- **Transdisciplinary** [included] establishing a common system of axioms for a set of disciplines.

More recently, Grigg (1999) selected the term cross-disciplinary in a report she wrote for the Australian Research Council (ARC) in order to encompass all of these forms of research more accurately than the term previously used by the Council – multidisciplinary. The term transdisciplinary is also growing in popularity as a description of research that is ‘at once between the disciplines, across the disciplines and beyond all disciplines’ (OECD 1998 quoted in Grigg, p. 4).

For this research project, the term interdisciplinary was chosen in an attempt to capture the interaction and synthesis several research centres where trying to achieve between the methodologies, theoretical paradigms and other knowledge resources of two or more disciplines. This definition of interdisciplinarity encapsulates the ‘bridging and fusion’ between disciplines.
that Koizumi (in OECD, 2002) defines as transdisciplinarity. Regardless of whether the term interdisciplinary or transdisciplinary research is chosen, the activities of these research centres aimed to go well beyond a multidisciplinary approach where groups work on various aspects of a common problem but from within their own disciplinary frames. In order to infuse this buzz word, interdisciplinarity, with meaning a comprehensive analysis of the literature was undertaken.

**Disciplinary-based discourses about interdisciplinarity**

One of the key findings emerging from this literature review was that, in almost all cases, disciplinary-based discourses and symbols were used to describe and analyse interdisciplinary research. These discourses and their associated symbols were grounded in the theoretical paradigms and methodologies of a number of disciplines including management, organisational psychology, professional disciplines such as health, engineering and the sciences, education and other social sciences, and the humanities.

In Management-based analyses of interdisciplinary research, there emerged an unproblematic identification and solving of the challenges involved in interdisciplinary research; a kind of 7 steps to successful interdisciplinary research approach common in business-orientated and self-help, pop-psychology books. The issues of change management, leadership, teamwork and communication were emphasised as key elements of successful interdisciplinary research work (Drucker, 1992 & Senge, 1990). These analyses of interdisciplinary research also borrowed and adapted the ‘communities of practice’ notion from educational discourses (Graham & Osgood, 1998). In a similar way, Organisational Psychology explorations of interdisciplinary research focused on the importance of leadership, teamwork, and communication (Robertson, 1983; Pearson, 1983; Argyris, 1999).

The literature on interdisciplinary research also contains many descriptive accounts from the Professions, including a range of Scientists, Engineers and Health Practitioners (Bella & Williamson, 1976; Robinson, 1996; Rossini et. Al., 1986). These accounts were very outcomes focused, emphasising the role of interdisciplinary research leader as project manager or ‘bridge scientist’ (Anbar, 1973). The notion of inter-professional work was embedded in many of the health examples (Higgs & Titchen, 2001). Analyses of these interdisciplinary research projects tended to focus on rational and pragmatic problem solving.

Authors writing from an Education-based perspective have also contributed to the increasing literature on interdisciplinary research. These authors tend to use the notion of ‘communities of practice’ to describe interdisciplinary research (Wenger, 2000) and to explore the single, double and triple loop learning that is involved in this type of research (Argyris & Schon, 1978). They perceive the interdisciplinary research leader as a broker between several disciplinary worlds and propose action research as a useful interdisciplinary methodology (Wenger, 1998 & 2000). More recently, they have explored the phenomenon of the knowledge economy and the associated need to move from mode 1 or disciplinary-based research to mode 2 knowledge production or transdisciplinary research (Gibbons et al, 1994; Nowotny et al 2001; Jacob, 2000; Conceiccao et al, 1998). These discourses on interdisciplinary research also focus on the social construction of research and knowledge and attempt to problematise the sometimes glib solutions offered in Management and Organisational Psychology discourses.

Finally, a number of authors explore interdisciplinary research using Humanities and Social Science discourses. These analyses tend to portray interdisciplinary research as a form of intercultural activity involving the crossing of a range of epistemological, theoretical and communication boundaries (Klein, 1990 & 1996; Snow 1964; Poole, 1994, McCarty, 2001).
They tend to investigate the range of historical, cultural and social perspectives influencing interdisciplinary research, which results in a deconstruction and critique of the neat, rational solutions suggested in Management and Organisational Psychology discourses. As a result, these analyses tend to take a problem making rather than problem solving focus (McCarty, 2001).

All of these discourses can be usefully framed by Bruhn’s (2000, p. 58) analysis of interdisciplinary research as ‘a philosophy, an art form, an artifact, and an antidote’. Exploring interdisciplinary research as a philosophy incorporates discourses about the boundary crossing and intercultural exchange involved in interdisciplinary research. The literature on the characteristics required by interdisciplinary researchers, including an ability to perceive the ‘big picture’ (also referred to as having ‘helicopter vision’ (Candy et. al., 1994), acting as a broker, bridge scientist or a ‘merchant trader’ of knowledge, developing effective teamwork, communication, and project management skills and responding to change, can be usefully explored by portraying interdisciplinary research as an ‘art form’. Bruhn (2000) highlights the non-linear ways of thinking, learning and problem solving required by successful interdisciplinary researchers when he refers to interdisciplinary research as an artifact. Finally, Bruhn (2000) claims that interdisciplinary research is often offered as an antidote to all the problems of the 21st century when disciplinary research is slow to offer answers and it is possible to perceive a similarly unrealistic trend within discussions of mode 2 knowledge. For this research project, Bruhn’s (2000) analysis of interdisciplinary research formed a sufficiently comprehensive portrait of the complex array of interdisciplinary skills we were trying to develop in the research graduates from two diverse interdisciplinary research centres at the University of Queensland.

Two diverse interdisciplinary research centres

The two interdisciplinary research centres taking part in this study were highly diverse contexts, which required the construction of different programs for developing research students’ interdisciplinary teamwork and communication skills. The Advanced Wastewater Management Centre (AWMC) is a small, innovative research centre. It consists of researchers and research students seeking to develop effective, sustainable solutions to the management of wastewater using the combined, interdisciplinary skills of microbiologists and chemical engineers. The centre currently also has a PhD student from the social sciences studying the integration of management, political and community aspects of sustainable urban water management.

By contrast, the other research centre featuring in this study, a Clinical Division of the Medical School is a loosely structured series of research teams working on a huge variety of medical projects across a number of hospitals in the Southeast Queensland area. These research teams include clinicians and wet lab scientists from a variety of medical and scientific sub-disciplines, practitioners from a range of therapies such as physiotherapy, dieticians, exercise physiologists and some social scientists.

Methodology

Different methodologies for the collection and analysis of data were adopted to suit the diverse contexts of the two research centres. In the AWMC, focus groups and sub-committees were used to collect and analyse data for the study. An initial briefing about the project at a centre staff meeting aimed to secure the support of centre director and staff. At this meeting it was decided that the project would focus on identifying and developing the graduate attributes of the centre’s research higher degree students as a framework though which to explore interdisciplinary research skills. Since the mid-1990s, universities in Australia and around the world have sought
to identify the broader, generic skills students develop during their studies in addition to content knowledge (Bowden et al, 2000). The focus of this graduate attributes agenda has largely been on undergraduate degree programs. More recently, universities have begun to explore how this agenda can be implemented in research higher degree programs, which have traditionally been regarded as curriculum-free zones (Holdaway, 1996; Cryer, 1998; Pearson & Brew, 2002). Data about AWMC students’ graduate attributes was gathered at separate staff and student focus groups, from which a subcommittee with academic staff, postdoctoral fellows, and research student representatives was formed to work with Catherine to finalise the interdisciplinary research skills program.

In a Clinical Division of the Medical School, it was decided in consultation with staff that issuing invitations to key researchers in the Division to participate in a series of interviews would be the most time-effective and appropriate method of gathering data. Several key researchers agreed to be interviewed about the:

- nature of their interdisciplinary research
- key skills, attitudes and behaviours necessary for effective interdisciplinary collaboration
- most effective methods of teaching these skills.

They also agreed that the project team could interview a number of students and research-only staff in the Division.

A content analysis of the interview and focus group data was conducted for both case studies in order to identify the significant themes and issues for each centre. This analysis then formed the basis of the planned interventions. While a number of academic and research-only staff and research students in the AWMC were closely involved in data analysis and planning, only one key member of the Clinical Division took a major role in data analysis and planning.

**AWMC program**

All AWMC members worked together to generate a list of the attributes of research graduates (see Table 1).

**Table 1: Attributes of Research Graduates of the AWMC**

| 1. High quality research skills. |
| 2. Expert integrated knowledge in the area of wastewater management. |
| 3. Effective communication skills. |
| 4. Problem-solving and problem-formulation skills from different perspectives. |
| 5. Project management skills. |
| 6. An industrial-focus and/or professional experience. |
| 7. The ability to understand and apply multiple disciplinary and international perspectives |
| 8. Social, ethical and environmental responsibility. |
From this, a Research Student Portfolio was created to assist students and supervisors to help develop and enhance students’ graduate attributes. Interdisciplinary research skills, attitudes and behaviours feature in each of these graduate attributes. There is no space to explore all of these graduate attributes in detail so two of the attributes that are most relevant to interdisciplinary research will be discussed: attributes 7 and 3. Developing an ability to understand and apply multiple disciplinary and international perspectives was perceived by members of the AWMC to include:

1. Multiple disciplinary perspectives:
   a. The student will be able to move beyond the comfort zone of their previous discipline in order to understand ideas, concepts, techniques and methods from other disciplines
   b. The student will be able to deal with the uncertainty and challenge involved in understanding new ideas, concepts, techniques and methods

2. Multiple international perspectives:
   a. The student will have accessed and learnt from local, national and international contacts and perspectives
   b. The student will have, as a result, developed an understanding of many cultural perspectives and approaches to wastewater management.

A list of concrete tasks or ways (or Key Performance Indicators - KPIs) of demonstrating the student’s development of these attitudes and approaches was then compiled as a guide for students and supervisors. This list was intended to be flexible enough to cater for each individual student’s learning needs and to reflect the fact that students will be at different career and life stages and that some students, who have more career/industry experience, may already demonstrate high levels of graduate attribute development. Some of the KPIs for this attribute include:

- The student has written a paragraph or verbally described how ideas, concepts, techniques and methods from other disciplines are similar and different from their original discipline/s and how they all fit into their research project
- The student has attended at least one international conference and described what they have learnt from their active participation and established personal contact with key local, national and international experts in the field of wastewater management.
- The student has described different ways of approaching wastewater management in different cultures and locations and indicated how they could be incorporated into their research project.

Similarly, communication skills were perceived to include effective written, oral, listening, and graphical presentation skills; and the ability to understand and value other people’s and other discipline’s ideas. Effective interdisciplinary team-working skills were included within communication skills and were seen as incorporating social skills, self-confidence, and conflict resolution and negotiation skills. Some of the concrete ways in which students could display their development of these communication skills included:

- Clearly expressing their ideas and results both orally and in a power point presentation, gathering feedback on their performance, and demonstrating how they have improved their presentation skills based on the feedback they have received
• Writing well-structured, highly effective reports and/or papers and indicating how they have attempted to improve their writing skills.
• Compiling an interdisciplinary literature review that will provide them with ways to expand their own work
• Actively participating in meetings and seminars showing that they understand other people’s perspectives
• Effectively participating in teamwork, by giving input to the general project and applying the outcomes to their own work.

Implementing the development of these interdisciplinary research attitudes and skills

In order to implement the development of these interdisciplinary research attributes a two-step process was constructed. This involved students completing a reflective exercise each year with their supervisor as part of a new annual review process and developing a portfolio that organises and documents their continuous development of graduate attributes and that could be used as a career development tool. For the increasing number of students attempting to secure employment outside the higher education sector, it is vital that they are able to produce evidence of their proficiency that employers are likely to acknowledge.

Care must be taken in developing research students’ portfolios to capture the level of sophistication they achieve in these graduate attributes. As Pearson and Brew (2002) emphasise, research students are capable of accomplishing more than merely listing their skills in project management for example. They become ‘skilful performers’ in these areas (Pearson & Brew, 2002, p. 4) and need to convince employers of this. Cryer (1998) recommended that students use a transferable skill framework, which was designed to generate students’ reflections about situations in which they had applied their skills and how they might frame and discuss these in ways that employers would appreciate. This is why many of the KPIs for AWMC’s graduate attributes ask students to write brief reflections on various demonstrations of their skill development. In conjunction with their supervisors, students would then devise an individual learning plan each year in order to enhance these attributes further.

Clinical Division program

A very different program was planned for the Clinical Division. A preliminary content analysis of the interview data collected from participants identified the widespread experience of physical, intellectual and emotional isolation by research students and by some research-only staff and the predominance of a master/apprentice model of postgraduate supervision. The majority of research leaders interviewed believed that interdisciplinary research skills were only learnt by immersion and could not be taught. Interviews with students, however, seemed to indicate that they were unaware that they were being immersed in an interdisciplinary research culture or being taught by example.

In an area where there appeared to be little communication and cohesion between diverse research teams and a lack of will to institute division-wide change, it was decided that working within the student body to improve communication, peer support and collaborative problem-solving was the most appropriate place to start. As a result, the project team and a committed staff member decided to incorporate interdisciplinary research skill development within the existing framework of learning sets or focus groups for research students. Acknowledging that the division’s research students came from diverse professional, cultural and disciplinary backgrounds, the student focus group was formed on the premise that this diversity was an asset
that should be exploited by its members. As a result, the key purpose of the Research Students’ Focus Group was to develop closer peer relationships, particularly aiming to enhance collaboration across disciplines, research teams and stages of study. A number of international students interviewed believed it would provide a particularly valuable forum for support and encouragement for them and a ‘chance to listen and discuss with other people. ... It offers the chance to speak English’ (interview, CD).

The Research Students’ Focus Group plans to meet for one hour every month with active participation from all group members. While the group will define its own direction, it is anticipated that there would be a standing agenda for each meeting. Participants will be allotted time at each meeting to direct discussion on their particular project area. Their colleagues will be expected to listen actively and support the presenting member collectively. The group may focus on:

(1) setting and meeting goals
(2) addressing common challenges facing research students
(3) developing specific approaches to problem solving
(4) facilitating a peer-directed support base for research students.

Group members will be encouraged to commit to participating for at least the first six meetings of the group. Members of the student group will be asked to keep reflective journals of their research work, which will serve as preparation for discussion at the group meetings. They will also be required to reflect on the outcomes of each group meeting and to revisit their journals at six monthly intervals to explore their progress during that period.

Discussion

As the project is ongoing and still in the planning stage, it is too early to report on the effectiveness of these programs. It is possible, however, to reflect upon the key features of the two programs. One of the central features of each program has been the need to embed further graduate attribute development and interdisciplinary research skills within students’ current research project rather than requiring them to do additional courses. This decision is supported by previous studies of developing students’ skills and attributes at undergraduate and postgraduate levels. Pearson and Brew (2002) warn of the dangers inherent in viewing graduate attribute development as bolt-on aspects of research education. As Pearson and Brew (2002) indicate, this mirrors the debate about embedding generic attributes in undergraduate degree programs (see Bowden et al, 2000). Cryer (1998, p. 212) suggests that these skills need to be embedded within students’ research degree programs so that they are ‘part of the students’ everyday thinking, help develop proficiency, facilitate transferability, and develop the habit of lifelong learning’.

There is an emphasis in both programs on using experiential, active, and interactive learning techniques to help students develop and enhance these skills and attributes (Biggs, 1999; Brookfield, 1990). Some of the key interdisciplinary research skills, such as the ability to understand and apply multiple disciplinary and international perspectives, to be flexible and have a high tolerance for ambiguity, and to develop social, ethical and environmental responsibility, are essentially about attitudinal change and development, which can be rarely taught didactically (Mezirow, 2000; Clifford, 1998). Even some of the more technical skills, such as effective communication and team working, are best learnt by doing (Jackson & Caffarella, 1994; Evans, 2000). In the Clinical Division’s program, there is an emphasis on peer learning and support
where students practice and enhance their collaborative, communication and problem-solving skills together (Boud et al, 2001).

Reflective techniques are also a key feature of each program and are recognised as a fundamental facet of effective professional practice. Schon (1983) and others (Cryer, 1998; Bolton, 2001; Evans, 2002) have demonstrated conclusively the importance of learning to reflect upon and systematically question your own decision-making and actions as a professional. By requiring students to write reflections on their ongoing development of important interdisciplinary skills and attitudes, each program aims to ensure that research students also enhance their ability to become thoroughly professional reflective practitioners.

The other key finding of this project to date relates to a number of process issues. Firstly, in planning for similar projects, it is important to factor in considerable time to muster political support and commitment for such projects. It is vital to acknowledge the massive time and funding pressures academic and research-only staff and research students experience and to work to devise programs that build upon existing structures and workloads. It is also important to allow enough time to develop localised, situated, and relevant programs and resources. This requires patient facilitation that responds to the needs of research students in different research contexts. A key finding of this study is that the actual programs for developing students’ interdisciplinary research skills may not be transferable at all. Instead, it may be the actual process and some of the resources that will be developed that may be transferable to other research contexts across the university.

Conclusion

This research project sought to develop a systematic program of interdisciplinary research activities in two research centres at the University of Queensland so that these research students would be provided with additional opportunities to develop interdisciplinary teamwork and communication skills. Bruhn’s (2000) analysis of interdisciplinary research provides a useful portrayal of the sophisticated array of skills this project sought to develop in these research students. The research team has facilitated the designing and planning of two different programs that respond to two very diverse research contexts. Inspite of these different approaches, both of these programs embed the development of students’ interdisciplinary research skills and attitudes within students’ research projects. They also emphasise experiential, active and interactive learning techniques and are centred upon the development of students’ reflective practice skills. Another key finding of this study is that the facilitative process needed to develop localised, situated and relevant programs in different research contexts may be the most transferable feature of the study rather than the actual programs themselves. Efforts will now be made to facilitate the process of designing effective, local programs across the university and to provide other research centres with access to the resources that are being developed. It is hoped that the widespread implementation of such programs will produce more researchers able to wrestle creatively with the complex, interdisciplinary problems of the 21st century.

References:


Candy, P. et al. (1994). Unpublished discussion paper for the HEC/AVCC project on *The enabling characteristics of undergraduate education*. Canberra: AGPS.


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